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## **Interrelationship of Forage and Moose in Game Management Unit 13**

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**Research Performance Report  
Federal Aid in Wildlife Restoration  
1 July 1998–30 June 1999  
W-27-2, Study 1.50**

This is a progress report on continuing research. Information may be refined at a later date.

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## RESEARCH PROGRESS REPORT

**STATE:** Alaska

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### SUMMARY

Willow treatments within exclosures in Tyone Creek and Oshetna River drainages were clipped at 30, 60, and 90% to simulate light, medium, and heavy rates of utilization by moose. Effects of sustained utilization at these rates will be determined. Percent winter utilization of feltleaf willows (*Salix alaxensis*) outside exclosures was 35% and 25%, respectively, for Oshetna River and Tyone Creek floodplains. Tall riparian willows have received light utilization for the last 4 consecutive years because moose have had relatively unlimited access to extensive upland stands of diamondleaf willow (*Salix pulcra*) during the same period. The fact that moose in the study area continue to have low reproductive rates indicates that some nutritional factor(s) other than winter browse availability is limiting moose productivity. Summer and fall diet quality should be examined for effects on growth and reproduction of moose in the study area.

**Key words:** *Alces alces*, browse utilization, diamondleaf willow, feltleaf willow.

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## BACKGROUND

The Alaska State Board of Game has selected human consumptive use as the priority for wildlife management in Game Management Unit (GMU) 13. In accordance with this priority, the Alaska Department of Fish and Game (ADF&G) must determine what biological potential may exist for increasing the productivity and/or harvest of game species, including moose. Management biologists question if Unit 13 moose are limited by forage resources, predation, or a combination of both.

Availability of nutrients to moose is one aspect of ecological carrying capacity that must be determined before these questions can be answered. Nutrient availability is affected by forage productivity and by factors that affect availability to the animal, including snow depth and previous utilization history. Assessment of these factors will be useful in development or modification of strategies to manage harvest and habitat for the welfare of Unit 13 moose.

According to Bishop and Rausch (1974), range condition has operated as a limiting factor to the moose population in Unit 13 in the past. Ballard et al. (1991) believed the degree of this limitation was unclear, but recognized the significance of severe winters and their influence on forage availability as probable causes of declines in Unit 13 moose productivity. They also recognized the significance of habitat decline resulting from fire suppression and subsequent vegetation succession.

Prior browse utilization can affect the quantity and quality of food available to moose (Moen et al. 1990, Wolff and Zasada 1979, Molvar et al. 1993, Danell et. al. 1994, McKendrick et al. 1980), causing decreases in moose reproduction (Franzmann and Schwartz 1985, Boer 1992) and increased mortality. Factors of snow accumulation in winter (Bishop and Rausch 1974, Schwab and Pitt 1991, Coady 1974, Telfer 1970 and 1978) and amount of solar radiation in summer (Bo

and Hjeltjord 1991) complicate forage-moose relationships. Frequency and intensity of fire also affect ecological carrying capacity for moose (Spencer and Hakala 1964, Wolff and Zasada 1979).

Milke (1969) ranked feltleaf and diamondleaf willows as highly preferred and as the two willow species most important to moose in Interior Alaska. Important willows not only are palatable and preferentially browsed but also are in such abundance or stature as to produce abundant, usable browse. In the study area, feltleaf willow is primarily a riparian species and typically grows 2 to 3 m tall, providing abundant browse above the level of snow accumulation. By contrast, diamondleaf willow primarily occupies hillsides and typically grows to heights of only 1 m or less, becoming covered by snow in years of average or greater accumulation. Both species are dominant in their respective habitats in the study area.

## **OBJECTIVES**

To identify relationships of moose browse availability and quality to utilization, I will test the following null hypotheses:

H1. Productivity of principal winter browse species in Unit 13A is not limited by previous levels of utilization by moose (tested at 4 levels of utilization).

H2. Crude protein, tannin, and digestible energy of current annual growth are not affected by browsing history of the shrub.

## **METHODS**

### **SEASONAL DIETS**

I am determining early, mid, and late winter diets of moose by backtracking them, then measuring and counting freshly browsed twigs at feeding sites. This will allow determination of forage species, plant parts, foraging rates, and diet mixing (Hobbs and Spowart 1984). Quantities of browse produced and percent utilization are being determined from twig counts in spring (Shafer 1965).

### **DIET QUALITY**

Principal foods (>5% of diet) and composite diets will be analyzed for tannin, digestible energy, and digestible protein (Robbins 1983). I will use collections of browse in April in nutritional analyses of winter browse and collections in July for summer analyses.

### **WINTER BROWSE AVAILABILITY**

Through twig counts and shrub density estimates, I am determining availability of winter browse species in principal vegetation types (riparian tall willow, hillside diamondleaf willow, and black spruce-willow communities) used by Unit 13 moose in winter. Availability is determined by height strata for stems less than 4 cm diameter at 1.5 m above ground (dbh), but only up to 2.5 m height for stems greater than 4 cm dbh.

Effects of browsing and clipping on feltleaf willow availability will be evaluated in terms of shrub survival, total current annual growth (CAG), distribution/availability of CAG, and browse quality. Feltleaf willow will be evaluated in this manner because it is the principal source of browse in severe winters when deep snow covers diamondleaf willow in upland sites. As such, these plants are most likely to be overbrowsed and most indicative of “carrying capacity.” Significance of numbers of catkins and seeds (Cook 1977) will also be investigated to determine their value as indicators of willow vigor.

Interpretation of browsing effects requires knowledge of browsing histories of individual shrubs (Shepherd 1971). Within the principal study area, browsing histories will be approximated through interpretation of shrub structures (numbers and chronological positions of previous browsing points) and supported by interpretation of historical moose trend-count data. Browsing effects will also be determined through clipping treatments, since histories of clipped plants are more certain. Four exclosures (600 m<sup>2</sup>) were constructed within riparian willow stands to protect clipping treatments from browsing interference by moose and caribou.

Each exclosure was divided into 4 equal quadrants, and all willows in each quadrant had been clipped at 1 of 4 levels of utilization (none, light, moderate, and heavy). Measurements of current annual growth, number of twigs, catkin production, and mortality are recorded for each of 30 permanently tagged stems within each quadrant. A “stem” is defined as any aboveground portion of the willow that at the soil surface is not visibly attached to any other part of the plant. “Heavy” clipping treatments are intended to simulate 90% utilization, or approximately 15% more than what Wolff and Zasada (1979) suggested represents the carrying capacity of feltleaf willow. “Light” and “moderate” levels of clipping approximate 30 and 60% utilization, respectively. Actual utilization as currently occurs outside the proposed exclosures will be treated as inference covariates in analysis of shrub responses. Shrub response will be analyzed following a repeated measures, randomized block design, blocking on site (exclosure) in each vegetation type.

## RESULTS

### SEASONAL DIETS

Percent of feltleaf willow twigs browsed in winter 1998–1999 remained low for a fourth consecutive year (Table 1), suggesting that relative browse availability was high. Low snow accumulation through the winter also reinforced the idea of good browsing conditions. However, moose were observed intensively browsing dwarf birch (*Betula nana*) in mid and late winter. Snow never buried dwarf birch by more than 5–10 cm at any time during the winter. The phenomenon of browsing on dwarf birch was preceded in early winter by moose utilizing only those feltleaf willow twigs growing within 50 cm of the ground, completely ignoring twigs growing within easier reach. Current annual growth was collected from varying heights in feltleaf willow and also from diamond willow and dwarf birch to determine what chemical differences may be responsible for the observed pattern of selection.

During the past 3 years, no 2-year-old cows, and less than 50% of 3-year-old cows, have reproduced, and only approximately 25% of all cows have produced twins (Ward Testa, personal communication), indicating some type of nutritional limitation.

In the past 4 winters, snow has not prevented moose from browsing extensive hillside stands of diamondleaf willow, and it has not limited them to riparian feltleaf willow stands, as in severe winters such as 1994–1995. Moose used riparian areas in December 1998 and early January 1999, when snow was less than 20 cm deep. During this time most moose were in groups of 6–15 animals. Later, groups broke up and moose scattered more uniformly across hillside diamond willow stands. Continued preferential use of hillsides by moose during the past 4 mild winters indicates preference for diamondleaf willow (and possibly dwarf birch) over feltleaf willow. Palatability and availability of feltleaf willow evidently does not attract and concentrate moose in narrow riparian zones, unless availability of other browse is reduced by snow accumulation. Nevertheless, feltleaf willow provides the only source of browse during winters when snow accumulates more than 60 cm and bends down and covers most diamondleaf willows and dwarf birch.

Unlike in June 1998, by early July 1999 no stripping of diamondleaf willow had occurred, but feltleaf willows were browsed. In 1998 very little summer browsing of feltleaf willow was observed.

#### **DIET QUALITY**

Collected browse has not yet been analyzed for digestible energy or digestible protein.

#### **BROWSING EFFECTS**

Number and mean lengths of current annual twigs under different levels of utilization were determined in exclosed clipping treatments in late March 1999, and treatments were clipped once again. Mean length of current annual growth multiplied by mean number of twigs per stem (Table 2) indicated that all 3 levels of utilization produced more current annual growth than the control which was not utilized. Plants utilized at 60% were most productive.

Catkin production under light utilization averaged 55% of the control. Catkin production under moderate and heavy utilization produced 27% and 3%, respectively, of the control. Number of unbrowsed twigs remaining from the previous year (i.e., in their second season of growth) obviously affected total catkin production because catkins only formed on those twigs. However, heavier utilization also reduced the number of catkins per unbrowsed twig.

By summer 2000, the enclosed shrubs will have had 4 growing seasons to respond to sustained levels of simulated moose utilization. Current annual growth will be measured and collected for nutritional analyses at that time.

### **RECOMMENDATIONS**

Clipping treatments in exclosures should be continued one more year to determine effects on shrub productivity, browse availability, and browse nutrient quality. Summer and winter browse should be analyzed for crude protein, tannin, and digestible energy to determine possible nutrient limitations to moose.

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Table 1 Percent utilization of feltleaf willow by moose. Standard deviations are in parenthesis

Twig height (m)	Oshetna River					Tyone Creek				
	1994	1995	1996	1997	1998	1994	1995	1996	1997	1998
0.5–1.5	n.d.	9 (11)	10 (10)	13 (9)	n.d.	n.d.	4(5)	5(5)	7(8)	n.d
1.5–2.5	n.d.	11 (3)	11 (5)	12 (14)	n.d.	n.d.	5(4)	7(7)	9(9)	n.d
Terminal	82.0 (22.2)	13 (12)	32 (12)	25 (10)	35 (13)	76 (16)	12(13)	29(10)	27(10)	24(14)

Table 2 Mean length of feltleaf willow current annual growth (cag)  
multiplied by mean number of cag twigs per stem

	Treatment % utilization			
	Control	30	60	90
Tyone S.	28.5	47.9	46.3	32.2
Tyone N.	25.1	34.8	44.6	36.3
Oshetna S.	59.9	65.8	82.1	67.5
Oshetna N.	77.0	83.8	103.6	84.8